REMARKS

Claims 1-30 are canceled without prejudice and replaced with new claims 31-63 to remove the "generally narrative" nature of the previous claims and to correct grammatical and idiomatic errors. Furthermore, the new claims particularly point out and distinctly claim the subject matter of the invention wherein the first reflective grating, or in the alternative the first, third and fourth reflective gratings, make up a fixed grating assembly and the second reflective grating makes up a mobile grating assembly (See Figures 1 and 2, and specification page 5, lines 17-29, and page 10, lines 5-11).

The amendment adds no new matter. In fact, the subject matter of original claims 1, 2-3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, and 30 correspond respectively to new claims 31-33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45-46, 47, 48, 49, 50-53, 54, 55, 56, 57, 58, 59, 60, 61, 62, and 63.

The Rejections

Claims 1-30 stand rejected under 35 U.S.C. 112, second paragraph, as being indefinite. The indefiniteness rejection is rendered moot in light of the cancellation of claims 1-30. Furthermore, Applicant asserts that new claims 31-63 particularly point out and distinctly claim the subject matter of the invention in compliance with 35 U.S.C. 112.

Claims 1 and 18-20 stand rejected under 35 U.S.C. 102(b) as being anticipated by

Kaneda et al. (EP 0 672 891). Claims 1, 7, 9 and 11-13 stand rejected under 35 U.S.C. 102(b) as being clearly anticipated by Rassudova et al. ("Ref. E").

Claims 2-6, 14-17, 21-23, 25, 29 and 30 stand rejected under 35 U.S.C. 103(a) as being obvious over Kaneda et al. Claims 28 stands rejected under 35 U.S.C. 103(a) as being obvious over Kaneda et al. in view of Ishii et al. (U.S. Patent 5,666,196). Claims 2-6, 8, 10, 21, 22, 29 and 30 are additionally rejected under 35 U.S.C. 103(a) as being obvious over Rassudova et al. Claims 23-27 are additionally rejected under 35 U.S.C. 103(a) as being obvious over Rassudova et al. in view of Kaneda et al. Claims 18-20 and 28 are additionally rejected under 35 U.S.C. 103(a) as being obvious over Rassudova in view of Ishii.

Applicant points out that the prior art rejection is rendered moot by the cancellation of claims 1-30. Applicant asserts that the present claims are clear and definite, and respectfully requests reconsideration and allowance of the present claims for the reasons set forth below.

The Invention

The present invention pertains to a device for measuring translation, rotation or velocity by utilizing diffracted light from a light source. Specifically, the invention includes a light source and at least one light detector, and a diffraction grating assembly placed between the light source and the light detector for diffracting light and creating an interference pattern. The diffraction grating assembly includes a fixed grating assembly and a mobile grating assembly.

Each one of these grating assemblies includes **at least one reflective grating,** as explicitly recited in claims 32 and 33, and as required implicitly by the term "reflective" used to describe the fixed reflective grating assembly and the mobile reflective grating assembly as recited in claim 31.

The reflective gratings of the present invention are an essential feature permitting a "flat," thin, two-level geometry previously not achievable by the prior art devices. This geometry means that no transmission element is needed as required by the prior art devices. The main advantage of the present invention is that no space or "thickness" is needed to accommodate the transmission element; therefore, manufacturing and assembly of the present device is facilitated and a degree of miniaturization by using integration and/or hybridization technologies is made possible.

The present invention determines the translation, rotation or velocity of the mobile grating assembly relative to the fixed grating assembly by measuring the intensity of light resulting from a diffraction pattern caused by interfering light beams reflected between the diffraction gratings carried by the fixed grating assembly and the mobile grating assembly. In this context, the term "mobile" defines motion relative to the fixed grating assembly as illustrated in Figures 1 and 2. In other words, the fixed grating assembly may be in motion in some of the embodiments of the invention, but this assembly is still considered the fixed reference point from which movement of the mobile grating assembly is determined.

It is additionally noted that the flat two level feature of the present invention, which is permitted by the language recited in claim 31, allows for the device to utilize the first and second reflective surfaces recited in claims 62 and 63. This compact structure is neither taught nor suggested by the recited prior art.

Lastly, the Applicant directs the examiner's attention to the "integrated measuring head" recited in claims 35-37 and shown in Figure 5. In this context, "integrated" means combining planar microelectronic and microsystem technologies for achieving miniaturization through monolithic integration of the components of the measuring head. Such a feature is not taught by any of the recited prior art.

In summary, the various claimed features of the present invention allow for the construction of a compact, miniature device for precisely measuring displacements as a result of the clever placement of reflective gratings and reflective surfaces, and the utilization of monolithic integration technologies.

Applicant's Arguments

As described above, the various claimed features of the present invention allow for the construction of a compact, miniature device for precisely measuring displacements as a result of the clever placement of reflective gratings and reflective surfaces, and the utilization of

monolithic integration technologies. The present claims 31-63 particularly point out and distinctly claim the novel features of the invention in compliance with 35 U.S.C. 112, second paragraph. Furthermore, the recited prior art does not teach or even disclose the novel and essential features of the present invention being the reflective fixed grating assembly and the reflective mobile grating assembly as recited in claim 31, the integrated measuring head recited in claims 35-37, and the compact structure comprising a first and second reflective surfaces as recited in claims 62 and 63.

Kaneda et al. (EP 0 672 891) discloses an "optical displacement sensor" for measuring relative displacement information of an object comprising an illumination system (1), a light-receiving element (3) and three diffraction gratings G1, G2, and G3 (see Figures 5A and 5B). A lens (4) condenses the light beam before it encounters the first grating G1. The diffracted light beam is subsequently diffracted by gratings G2 and G3 before creating an interference pattern at the light-receiving element (3). A non-integrated "head unit" (H) comprising several assembled components houses the "the light projection means and the light-receiving means" (column 4, lines37-40). Kaneda et al. does not teach or even suggest that the head unit can be an "integrated" head unit. In fact, Kaneda et al. teaches that the light-emitting element (1) and light-receiving element (3) are "spatially separated" (column 10, lines 30-34). It is clear that Kaneda et al. is teaching away from forming an integrated head unit.

Furthermore, there is no teaching or suggestion in Kaneda et al. that there are first and

second reflective surfaces.

Lastly, gratings G1 and G3 are clearly shown as transmitting diffraction gratings as is plainly shown in Figure 5A. There is no teaching or suggestion in Kaneda et al. that gratings G1 and G3 are reflective gratings. Consequently, Kaneda et al. can not anticipate the subject matter of claim 1. The Applicant also points out that as gratings G1 and G2 are not reflective, each must be located between the light source and the light detector on the one hand and the "scale" or G2 grating on the other hand. Consequently, the device disclosed by Kaneda et al. is necessarily a "three level" device having scale grating G2 on one level, gratings G1 and G3 on another level, and the light source and light detector on a third level. Therefore, by using the Kaneda et al. arrangement it is not possible to integrate the light source, the light detector and the G2 grating together as is the case in the present invention as recited in the subject matter of claims 35-37.

Rassudova et al. (Ref. E) discloses a combination of "reflecting and transparent diffraction gratings" to obtain interference Moire bands (see abstract). As shown in Figures 2a and 2b, the Rassudova reference teaches the use of exclusively transmitting gratings in combination with exclusively reflective gratings. Consequently, Rassudova can not anticipate having both the fixed grating assembly and the mobile grating assembly with the feature that they are both reflective as recited in claim 1.

The Rassudova reference is also silent with respect to the feature of an integrated measuring head and the first and second reflective surfaces. Plainly, the Rassudova reference can not make up even one of the deficiencies of the Kaneda et al. reference.

Ishii et al. disclose an "optical detection apparatus" in Figure 2A comprising a light source (1), photosensors (4B,4C,4D, 4E) and diffraction gratings (3A), (21) and (3B, 3C, 3D, 3E). As shown in Figure 2A, diffraction gratings (3A) and (21) are transmission gratings only, and the remaining gratings are reflective; therefore, the Ishii et al. reference does not teach or suggest that both the fixed grating assembly and the mobile grating assembly are reflective as required by the language of claim 1 of the present invention. Furthermore, Ishii et al. clearly shows that the light source (1) and the photosensors are separate and distinct, effectively teaching away from Applicant's integrated measuring head. Lastly, Ishii et al. reference is silent with respect to the first and second reflective surfaces. Apparently, the Ishii et al. reference does not make up any of the deficiencies of the Kaneda reference and the Rassudova reference.

Conclusion

Applicant asserts that claims 31-63 particularly point out and distinctly claim the subject matter of the present invention in accordance with 35 U.S.C. 112, and that the recited prior art discussed above neither teaches, nor suggests, alone or in combination the features of the fixed reflective grating assembly and the mobile reflective grating assembly as recited in claim 1, or the integrated measuring head recited in claims 35-37, or the first and second reflective surfaces

recited in claims 62 and 63. Therefore, Applicant respectfully requests reconsideration of the application and allowance of claim 31-63 for the reasons evinced clearly herein. Questions are welcomed by the below-signed attorney for Applicant.

Respectfully submitted,

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